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An apparatus for the surface working of a workpiece as well as the use of the apparatus for the blasting of bore walls

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The invention relates to an apparatus for the surface working of a workpiece by blasting with an abrasive blasting material as well as to the use of the apparatus for the blasting of bore walls in accordance with the preamble of the independent claim of the respective category.

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For the pre-treatment of workpieces, in particular for the pre-treatment with thermal coating, surfaces of components are frequently activated by blasting, for example with aluminium materials. This ensures, among other things, a sufficient gripping engagement of a coating material with the substrate. However, blasting, is also frequently used as a suitable method for the roughening and even for the compacting of surface layers (introduction of internal stress by peening) of surfaces, such as, for example, with classical sandblasting, with – in addition to conventional sand – also other materials such as ceramic powders, special metallic powders or other powders or fine dusts being used as the blasting material. The method of blasting is, among other things, widespread and particularly suitable for the working of bore walls and tube walls, since the surfaces of such internal walls can often only be worked with difficulty using other methods.

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For this reason, a whole series of apparatuses and methods are well-known in the prior art for the working of surfaces of workpieces by blasting. For instance, an apparatus known as a RotaBlast and a corresponding method are described in EP 0 727 282 B1, for example, in which a
5 blasting material is stored in a storage container of sufficient size and is supplied from there to a suitable metering device which is arranged directly beneath the storage container. After having been metered by the metering device, the blasting material is then transported with the help of an injector with compressed air into a blasting means transport hose
10 flanged directly to the injector and also known as a blasting means pressure hose. The blasting material is transported by the blasting means transport hose, which is made up of special rubber material, possibly with an India rubber liner, to the RotaBlast apparatus for the blasting of a workpiece.

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Currently, high wear phenomena occur at the blasting means transport hoses. The hoses, which are mostly made, as already mentioned, from a plastic or rubber, wear out in particular at a spacing of approximately 100 mm to 150 mm from the outlet of the blasting material from the
20 injector. Strong flow turbulence occurs in this region which wears the hose material abrasively even more from the inside in this region due to the blasting means transported in the airflow. This results in the hoses being so heavily worn even after a very short operating time that the operation of the plant has to be stopped and the worn blasting means transport hoses have to be replaced. A further disadvantage of the overpressure
25 principle briefly described above consists of the fact that the transport of the blasting material requires compressed air which is especially prepared with the aid of the injector and which has to be made available by the user. This requires appropriate additional plants with the corresponding
30 financial and labour effort.

It is therefore the object of the invention to provide an improved apparatus for the surface treatment of a workpiece by blasting with an abrasive blasting material which avoids the disadvantages of known apparatuses
5 from the prior art.

The subject matters of the invention satisfying these objects are characterized by the features of the independent claim of the respective category.

10 The dependent claims relate to especially advantageous embodiments of the invention.

In accordance with the invention, an apparatus for the surface working of a workpiece by blasting with an abrasive blasting material is thus proposed including a storage container for the blasting material, a metering
15 device and a device for blasting. The device for blasting has a blasting material feed with an inlet and an outlet for the blasting material, with the blasting material being able to be fed to a jet region through the blasting material feed and the outlet. The device for blasting furthermore includes
20 a pressure supply for the deflection by means of a pressure medium of a blasting material flow emerging from the outlet, with control means being provided at the inlet of the blasting means feed for the introduction of the blasting material flow.

25 Since, in the apparatus in accordance with the invention for the blasting with an abrasive blasting material, the control means – which can in particular include, as will be explained in more detail further below, a metering device or an injector nozzle – are arranged directly at the inlet of the blasting means feed of the device for blasting, the blasting material is
30 no longer fed to the blasting material feed, as is known from the prior art,

by means of overpressure through a blasting means pressure hose, whereby the known problems with premature wear phenomena of the blasting means pressure hoses are avoided.

- 5 The device for the blasting of the apparatus in accordance with the invention is known per se from the prior art and substantially includes a blasting material feed, for example in the form of a tube, which has an inlet and an outlet, with an abrasively acting blasting material being able to be fed to the inlet which can be discharged again through the outlet of the
- 10 blasting material feed in the form of a blasting material flow in a jet region. The blasting material feed is preferably, but not necessarily, arranged vertically, that is parallel, to the action of gravity such that the blasting material can reach the outlet of the blasting material feed in a blasting material flow from the inlet solely by the action of gravity.
- 15 The blasting material flow emerging from the outlet is deflected by means of a pressure medium, which can be fed to the jet region via a pressure supply, onto a surface of a workpiece to be worked, whereby the surface of the workpiece is worked. The pressure medium for the deflection of the
- 20 blasting material flow can include, for example, a fluid such as compressed air, or also a suitable liquid or another suitable medium.

The blasting material can be fed to the control means provided at the inlet of the blasting material feed of the device for blasting from a storage container for the blasting material, with the control means being suitable for

25 the introduction of the blasting material flow into the inlet of the blasting material supply. For the controlled feed of blasting material from the storage container to the blasting material feed, the apparatus in accordance with the invention includes a metering device known per se

In a preferred embodiment of an apparatus in accordance with the invention, the control means for the introduction of the blasting material flow includes the metering device. This means that the metering device is arranged directly at the inlet of the blasting material feed. The storage container for the blasting material can be arranged in a first embodiment directly at the metering device such that no feed line is provided for the feed of blasting material from the storage container to the metering device. Alternatively, in a second embodiment, the control device designed as a metering device can be connected to the storage container via a feed line. Auxiliary means can be provided which support the feed of the blasting material from the storage container to the control means. In particular, the blasting material can be fed from the storage container to the control means by means of a transport medium, for example by air. It is naturally also possible that blasting material is supplied from a storage container to a plurality of devices for blasting.

In another important embodiment for practice, the control means for the injection of the blasting material flow include an injector nozzle known per se, with the injector nozzle being connected to the metering device via a connection line such that blasting material can be fed from the storage container to the injector nozzle via the metering device and the connection line. The metering device can in particular be arranged directly at the storage container. The blasting material is introduced by the injector nozzle via the inlet of the blasting material feed directly into the blasting material feed under a pre-settable pressure as a blasting material flow. The injector nozzle known per se, which can be operated with compressed air, produces an underpressure in the connection line, whereby the blasting material is sucked to the injector nozzle. Hardly any turbulence is hereby created in an inlet region of the connection line, which is preferably made of a plastic, for example rubber, so that the connection line is

not exposed to any excessive abrasive wear like the blasting means pressure hoses known from the prior art.

5 The connection line and/or the feed line is/are lined at its/their inner wall, preferably with boron carbide. Boron carbide is a known and suitable material for the reduction of wear, in particular on the use of abrasively acting materials, and is therefore also preferably used for the injector nozzle.

10 In a variant important for practice, the injector nozzle is preferably made up of boron carbide and is exchangeably connected to the blasting material feed and/or to the connection line. In particular the transition to the connection line and/or to the blasting material feed is designed by the use of a transition nozzle such that, where possible, no turbulence occurs in
15 the flow of the blasting material, whereby the wear of the components involved can be substantially reduced.

In a particularly preferred embodiment, the pressure supply includes an endpiece which deflects the pressure medium in the jet region and has an
20 opening from which the pressure medium is discharged into the jet region. The pressure supply is rotatably arranged about a longitudinal axis of the blast material feed, with the opening of the endpiece of the pressure supply being arranged and alignable such that the blasting material flow emerging from the outlet of the blasting material feed can be deflected
25 onto a workpiece to be blasted. The pressure supply can be rotatable by a rotary drive about the blasting material feed. An electric motor, a pneumatic or a hydraulic drive, or another suitable drive can be used, for example, as the rotary drive.

The apparatus in accordance with the invention preferably includes a flowmeter for the monitoring and measurement of a mass flow of the blasting material. The flowmeter can, for example, be provided in the connection line or in the feed line or at any other suitable position at the
5 apparatus in accordance with the invention.

The apparatus in accordance with the invention can in particular include a freely programmable control unit for the control and/or regulation of the metering device and/or of the control means for the introduction of the
10 blasting material flow and/or of the rotary drive. In a variant important for practice, regulation means can be provided, for example in the form of suitable valves, with which the mass flow can be controlled and/or regulated by the control unit in dependence on pre-settable operating parameters. The flowmeter is preferably connected by signal to the control unit for
15 the transfer of actual data of the mass flow so that, for example, the actual mass flow can be used for the control and/or regulation.

In accordance with the invention, the use of the apparatus is furthermore used for the surface working of a workpiece by blasting with an abrasive
20 blasting material, for the blasting of bore walls or tube walls, in particular of cylinders of reciprocating internal combustion engines.

The invention will be described in more detail in the following with reference to the schematic drawing. There are shown:
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Fig. 1 an apparatus in accordance with the invention with a storage container, a metering device and a device for blasting;

Fig. 2 a further embodiment of an apparatus in accordance with the
30 invention.

Fig. 1 shows, in a schematic representation, an apparatus in accordance with the invention for the surface working of a workpiece by blasting with an abrasive blasting material, which apparatus is designated as a whole
5 by the reference numeral 1 in the following.

The apparatus 1 in accordance with the invention includes a storage container 4 for a blasting material 3, a metering device 5 and a device for blasting 6. The device for blasting 6 has a blasting material feed 7 with an
10 inlet 8 and an outlet 9 for the blasting material 3, with the blasting material 3 being able to be fed to a jet region 10 through the blasting material feed 7 and the outlet 9. The device for blasting 6 furthermore includes a pressure supply 11 for the deflection of a blasting material flow 12 emerging from the outlet 9 by means of a pressure medium (13), with control
15 means 14 being provided at the inlet 8 of the blasting material feed 7 for the introduction of the blasting material flow 12.

The device for blasting 6 shown in Fig. 1 is known per se from the prior art, as is the metering device. The blasting material feed 7 is designed in
20 the form of a straight tube 7 which is arranged in accordance with the representation in the embodiment shown in Fig. 1 in a perpendicular manner, that is with its longitudinal axis L parallel to the effective direction of gravity. The control means 14 for the introduction of the blasting material flow 12 are here designed as a metering device 5. This means
25 that the metering device 5 is arranged directly at the inlet 8 of the blasting material feed 7. The storage container 4 for the blasting material 3 in the embodiment shown here is arranged directly at the metering device 5 such that no feed line to the feed of the blasting material 3 is provided from the storage container 4 to the metering device 5. The transport of the blasting
30 material 3 into the blasting material feed 7 takes place solely by gravity.

The same applies to the transport of the blasting material 3 in the form of the blasting material flow 12 from the inlet 8 to the outlet 9 of the blasting material feed 7.

- 5 The blasting material flow 12 emerging from the outlet 9 can be deflected by means of the pressure medium (13), which can be supplied to the jet region 10 via the pressure supply 11, onto a surface of a workpiece 2 to be worked, whereby the surface of the workpiece 2, for example the inner wall of a cylinder of a reciprocating combustion engine, is worked. The
10 pressure medium (13) for the deflection of the blasting material flow 12 can include, for example a fluid (13) such as compressed air, or also a suitable liquid (13) or another suitable medium (13).

- The pressure supply 11 includes, in the jet region 10, an endpiece 71
15 which deflects the pressure medium (13) and has an opening 72 from which the pressure medium (13) is discharged into the jet region 10. The pressure supply 11 is rotatably arranged and is alignable about the longitudinal axis L of the blasting material feed 7, with the opening 72 of the endpiece 71 of the pressure supply 11 being arranged and alignable such
20 that the blasting material flow 12 emerging from the outlet 9 of the blasting material feed 7 can be deflected onto the workpiece 2 to be blasted. In the variant shown here, the pressure supply 11 can be rotated about the blasting material feed 7 by a rotary drive 17, with the rotary drive preferably being designed as an electric motor or as a pneumatic drive or as a
25 hydraulic drive.

- The apparatus 1 in accordance with the invention can in particular have a sensor not shown in Fig. 1, in particular a flowmeter (15) for the measurement of a mass flow of the blasting material, which is provided with a
30 freely programmable control unit, likewise not shown, for the control

and/or regulation of the metering device 5 and/or of the control means 14 for the introduction of the blasting material flow 12 and/or of the rotary drive 17.

- 5 In Fig. 2, a further embodiment of an apparatus in accordance with the invention is shown schematically. In this embodiment, which is important for practice, the control means 14 for the introduction of the blasting material flow 12 include an injector nozzle 141 known per se, with the injector nozzle 141 being connected to the metering device 5 via a connection line 16 such that blasting material 3 can be fed from the storage container 4 to the injector nozzle 141 via the metering unit 5 and the connection line 16. The connection line 16 includes a flowmeter 15 for the measurement of a mass flow of the blasting material 3 which is connected by signal to a control unit (not shown). The metering device 5 is in particular arranged directly at the storage container 4. The blasting material 3 is introduced directly into the blasting material feed 7 by the injector nozzle 141 as a blasting material flow 12 via the inlet 8 of the blasting material feed 7 at a pre-settable pressure. The injector nozzle 141 known per se, which can be operated with compressed air, produces an under-
10 pressure in the connection line 16, whereby the blasting material 3 is sucked to the injector nozzle 141. Hardly any turbulence hereby occurs in an inlet region of the connection line 16, which is preferably made up of a plastic, for example rubber, such that the connection line 19 is not exposed to any excessive abrasive wear like the blasting means pressure hoses known from the prior art.
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